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Sensory Profile and Consumer Acceptability of *Ziziphus mauritiana* and Processing Product in Savannah Region of Cameroon

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Authors' contributions

This work was carried out in collaboration between all authors. Authors CT and PB conducted the field work (sample collection, sensory and consumer analyses). Author RN designed the work, co-supervised the field work and wrote the first draft of the manuscript. Author GF coordinated the sensory evaluation and consumer test. Authors KIT and AB supervised the data analysis of sensory and consumer tests. Author DP coordinated the work in the framework of after project and validated the protocols

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ABSTRACT

Aim: *Ziziphus mauritiana* is an endemic fruit spread in the savannah region of Cameroon. The fruit, locally called *Jaabi*, is harvested dry and consumed as such or processed into a local cake named *Yaabande*, using three baking techniques (sun drying, steam baking and stifle baking). The aim of the study is to characterize the sensory profile and consumer acceptability of the fruit and its processed product, in order to evaluate the determinant of their quality attributes as influenced by ecotype, origin and processing method.
Place of Study: The study was carried out in the Department of Food Science and Nutrition,

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University of Ngaoundéré, Cameroon.
Methodology: Physico-chemical analysis, sensory profile by a semi trained panel, and consumer acceptability of the fruits and their processed products were undergone through collection of two ecotypes of the fruit (*Jaabi Dakamji* and *Jaabi Lammuji*) from four areas (Garoua, Mora, Maroua and Mokolo). African and non African consumers were used for the consumer tests.
Results: Sensory analysis differentiated the fruits by ecotype and origin, with the *Dakamji* ecotype appearing more homogeneous whatever the origin. The processed cakes differed mainly by their texture, depending on the baking method, with chewing texture for sun processed method, while samples from steam and stifle baking were more firm in mouth. Meanwhile, all samples were acceptable at comparable level corresponding to pleasant character, the sweet taste constituting the main criteria for consuming the products, both for African and non African consumers. In this respect *Dakamji* ecotype was sweeter, due to its higher sugar content, while the sweetness of *Lammuji* ecotype was lowered by its acid content.
Conclusion: *Jaabi* and *Yaabande* samples are globally acceptable by consumers, whatever the origin and the variety. Development of products emphasising the original taste of *Jaabi* and standardisation of processing techniques appear as some main aspects of the market development of the fruit.

Keywords: Ziziphus mauritiana; Jaabi; Yaabande; sensory profile; consumer acceptability.

1. INTRODUCTION

Jaabi is, in Cameroon, the local name of the fruit of jujube tree (*Ziziphus mauritiana*), an endemic tree, largely spread in the savannah region of the country. The fruit is harvested dry and mainly consumed as side-dish. Its pulp is also pounded into flour which is then processed into a local cake called "*Yaabande*". The processing of the fruit into *Yaabande* represents a form of conservation of the product which is consumed throughout the dry season, and even thereafter. In spite of the fact that *Jaabi* and *Yaabande* are currently sold on local market during the harvesting season, these products have not attracted significant scientific interest. *Jaabi* is then one of the underutilized plant species which has not received any benefit in terms of control of the cropping system or development for markets, contrary to the Asian practices where the jujube fruit is valorized into different foods and pharmaceutical products, with market, technology and quality development [1].

Out of information provided by Noyé [2] on *Yaabande*, no scientific study exists on *Jaabi*. It is, in fact, evident that understanding the local production and processing systems of *jaabi*, in relation with its characteristics and quality, constitutes one of the main steps to fulfill, in order to set up technology and market development of the product.

In this respect, a survey of *Jaabi* production, processing, trading and consumption systems in savannah area of Cameroon has identified two consumable ecotypes of *Ziziphus mauritiana* locally called *Jaabi Lammuji* and *Jaabi Dakamji*, and has shown that the processing practice, exclusively traditional, is the panacea of women who use steam cooking, sun drying or stifle cooking to bake the cake. The quality attributes of the products, as perceived by operators and consumers are based mainly on the maturity of *Jaabi* grain, and the color and texture of the cake [3].

Diversity of processing practices and even diversity of *Jaabi* varieties results in diversity of appreciation and quality of the products on the market. Since consumer acceptance is important in marketing strategy and economic viability for product development [4], the present study explore the sensory profile and acceptance of *Jaabi* and *Yaabande* harvested and processed in the savannah regions of Cameroon, assuming hypothetically that *Jaabi* variety and origin, and processing practices influence the acceptability of products.

2. MATERIALS AND METHODS

2.1 Sampling of *Jaabi* and *Yaabande*

Jaabi and *Yaabande* were collected in four areas of the savannah region of Cameroon (Garoua, Mora, Maroua and Mokolo), between December 2011 and January 2012 (Fig. 1). For each sampling area, the two ecotypes of consumable *Jaabi* (*lammuji* and *dakamji*) were collected. In addition, *Yaabande* processed from each ecotype, according to the processing method available locally was also collected. A *Yaabande*

sample of mixed *Jaabi* origins was also collected from a processor in Garoua. The processing methods identified included: Molding of the flour in small calabash or wrapping in vegetable leaves, followed by steam cooking (using traditional steam r [3], sun drying (exposition of the molded product under sun for one or two days) or stifle cooking (by introducing samples wrapped in leaves under hot ash).

Both harvesters and processors in each sampling area were selected and sensitized in order to guarantee the original quality of collected products. A total of 18 samples were collected, made of 8 samples of *Jaabi* grains (2 ecotypes and 4 origins) and 10 samples of resulting *Yaabande* (Table 1).

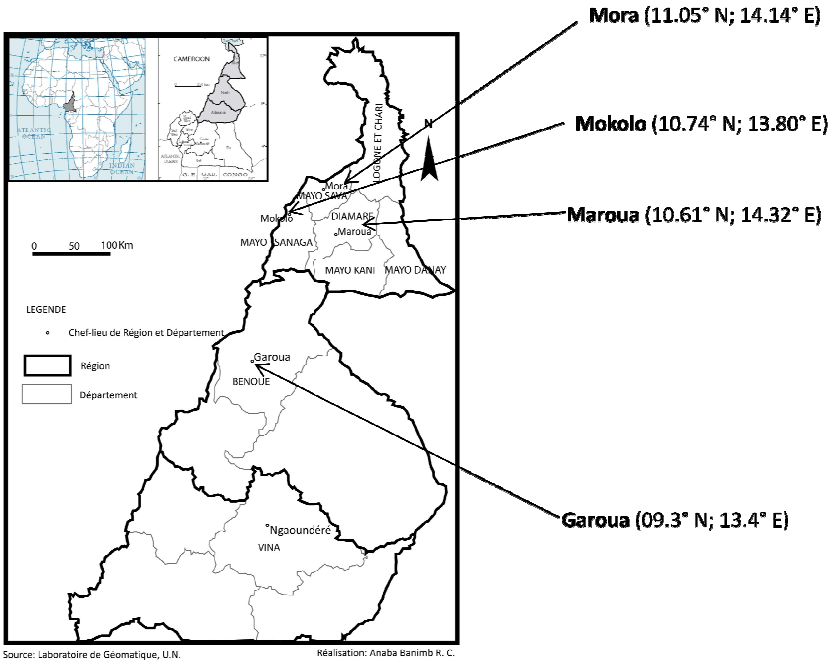

Fig. 1. Sampling areas of *Jaabi* and *Yaabande*

Table 1. Characteristics of collected samples of *Jaabi* and *Yaabande* according to variety, origin, and processing method

***Jaabi* ecotypes**	**Origin**	***Jaabi* codes**	***Yaabande***		
			Steam cooking	**Sun drying**	**Stifle cooking**
Lammuji	Garoua	L-Ga	L-Ga-Vapor		
	Maroua	L-Ma	L-Ma-Vapor		
	Mokolo	L-Mk	L-Mk-Vapor		
	Mora	L-Mo		L-Mora-Sun	
Dakamji	Garoua	D-Ga	D-Ga-Vapor		
	Maroua	D-Ma	D-Ma-Vapor		D-Ma-Stifle
	Mokolo	D-Mk	D-Mk-Vapor		
	Mora	D-Mo		D-Mo-Sun	
Mixed	Garoua	Mix-Ga	Mix-Ga-Vapor		

Samples are codified for Ecotypes (L=Lammuji, D=Dakamji, Mix=Mixed samples bought on the market), Origin (Ga=Garoua, Ma=Maroua, Mk=Mokolo, Mo=Mora) and processing method (Vapor=Steam cooking, Sun=Sun drying, Stifle=Stifle cooking)

2.2 Sensory Evaluation

Jaabi and *Yaabande* samples were scored by a semi-trained sensory panel using a modified version of quantitative descriptive analysis (QDA) since standards were not provided [5,6]. The panel was composed of university technicians and students (17 people in total for *Jaabi* tests and 19 for *Yaabande* tests). Sessions were conducted in a dedicated sensory evaluation room at ambient temperature (22 to 25℃). The panellists were previously screened for familiarity with the product. Sensory attributes were generated during a preliminary focus group session guided by the panel leader. These sensory attributes generated are presented on (Table 2).

After a period of training using these attributes, the 8 *Jaabi* samples and 11 *Yaabande* samples were tested blind in triplicate by the panel and the order in which they were presented was random. At each session, four samples of *Jaabi* or *Yaabande*, coded with 3 figure random numbers, were served either on a white paper or in a white dish, in random order to each panelist, who had to score sensory attributes on a 100 mm unstructured scale, anchored with terms related to minimum intensity at the left end and maximum intensity at the right end.

2.3 Consumer Acceptability

African (116 for *Jaabi* and 164 for *Yaabande*) and European (38 for *Jaabi* and 35 for *Yaabande*) consumers were interviewed in different locations of Garoua, Maroua and Ngaoundéré towns using the central location method [5]. The locations were hotels, market places, coffee shops, Universities (Ngaoundéré and Maroua).

Five *Jaabi* samples and four *Yaabande* samples were selected for consumer testing, based on the results of sensory testing. During acceptability testing, each consumer was invited to taste each *Jaabi* or *Yaabande* (presented in random order and coded with three figure random numbers). Consumers were asked to score the acceptability with respect to appearance, taste and overall liking using a nine-point verbal hedonic box scale which varied from dislike extremely (1) to like extremely (9)[5]. In addition, consumers were asked to justify with their own terms the reason of acceptability of products. Along with the testing, information was elicited from each consumer regarding demographics, education and products consumption and buying. Trained enumerators assisted the consumers when required. The interview procedure (acceptability and the questionnaire) lasted no more than 30 min.

Table 2. Sensory attributes of *Jaabi* and *Yaabande*

Jaabi	***Yaabande***
Appearance	**Appearence**
• Color • Aspect (smooth, rough) • Defect aspect (spots, holes, dirt…)	• Color • Presence of spots (inside and outside) • Aspect (friable- compact) • Fineness
Odor	**Odor**
• Dry fruit odor • Dusty odor • Grilled odor (biscuit, cake, caramel)	• Fruity • Grilled
Texture	**Texture**
• Skin texture (on crunching) • Global texture (on crunching) • Flesh thickness • Flesh texture (on chewing)	• Firmness • Chewing texture • Fineness
Taste	**Taste**
• Sweet • Acid • Fruity	• Sweet (fruit, candy…) • Acid • Biscuit • After taste (Bitterness, astringence, …)

2.4 Physico-chemical Analyses

Titrable acidity and reducing sugar of *Jaabi* samples were determined using standard methods [7,8]. In addition the pulp mass of fruits was determined by knife removal and weighing of the pulp of 100 fruits.

2.5 Data Analysis

All data were treated using XLSTAT Version 2007.8.04 package. The main analyses undergone in this respect were analysis of variance (ANOVA), Principal Component Analysis (PCA), Hierarchical clustering and correlations.

3. RESULTS AND DISCUSSION

3.1 Physico-chemical Characterization of Jaabi

From physico-chemical point of view, *Jaabi* samples appear different by ecotype and by origin (Table 3). *Dakamji* ecotype has higher sugar content, while *Lammuji* is characterized by higher acidity. This may justify the local names given to the two ecotypes, *Dakamji* for sweet taste and *Lammuji* for bitter or acid taste. While titrable acidity of *Dakamji* is identical whatever the origin, the *Lammuji* from Garoua is far more acid than all other samples. In the same way, Maroua samples, whatever the ecotype, are characterized by the lowest mass pulp, on the contrary to samples from Mora, which are fleshier.

3.2 Sensory Profile of Jaabi and Yaabande

The relationships between the sensory attributes of the products are summarized using Principal Component Analysis (PCA). For the *Jaabi* fruits, up to 61.77% of these relationships can be represented by the first two main components (F1 and F2) as shown on (Fig. 2). Texture attributes (global texture, skin texture, flesh texture) and color intensity are positively deployed on F1 axis. F2 component carries positively, aspect (smooth – rough) and dry fruit odor attributes, and negatively, flesh thickness and acid taste. Though the resolution is too low, the graph shows that *Jaabi* can be differentiated both by its ecotype and origin. *Lammuji* fruits from Mora (L-Mo) and from Mokolo (L-Mk) are associated to smooth or rough aspect, while the same variety from Garoua is mainly associated to pulp thickness and acidic taste. On the other hand, the *Lammuji* from Maroua (L-Ma) presents common sensory attributes with the *Dakamji* ecotype from all regions. In this respect, the *Dakamji* ecotype from different origins seems more homogenous than the *Lammuji* ecotype as shown by the sensory profile of each ecotype (Fig. 3). Dakamji ecotype, whatever the origin, is mainly characterized by its dark color, its texture (pellicle, overall fruit and pulp) and its odor (dust or grilled). In general, *Dakamji* presents higher means for these attributes. It should be noted that sweet and fruity tastes are almost common at relative equal value for the different samples, except for *Lammuji* Garoua (L-Ga) in which the sweet taste is lowered by high acidity.

The dispersion of *Lammuji* ecotype with respect to origin may be explained by variability of harvesting conditions of the fruits in the different regions. With regards to this hypothesis, all samples were not harvested at the same moment; thus the difference in the maturity of fruits may results in difference in their taste. In addition, fruits are not harvested from tree. They are harvested by field collection of mature and dry fruits fallen from jujube trees [3]. This practice may justify both the dust odor of fruits and a modification of color and aspect attributes, depending on the time the fruit stays on the earth. The harvesting and manipulation conditions may also explain the presence of defection on *Jaabi* fruit. In this respect, samples from Mokolo are more concerned, with the highest means for this attribute.

Correlations between all sensory attributes, including physicochemical data, indicate that in *Dakamji* ecotype (Table 4), the grilled odor of the fruit is correlated positively with the color intensity of the fruit and its dry fruit odor, and negatively with the pulp mass; while the latter is negatively correlated to dry fruit odor. For *Lammuji* ecotype (Table 5), color intensity, grilled odor and skin texture are positively correlated; while dry fruit odor is positively linked to sweet taste and negatively to acid taste. In addition, *Lammuji* sweet and acid tastes are inversely related, the acid taste being due to high acidity of the product.

Table 3. Some physico-chemical characteristics of *Jaabi* samples

Jaabi ecotypes	Origin	Pulp mass (g)	Soluble sugar (% DM)	Titrable acidity (g citric acid/100 DM)
Lamouji	Garoua	0.28 ± 0.02	9.80 ± 0.30	7.2 ± 0.3
	Maroua	0.22 ± 0.01	9.01 ± 0.30	3.6 ± 0.1
	Mokolo	0.24 ± 0.01	9.40 ± 0.30	3.8 ± 0.1
	Mora	0.29 ± 0.01	9.10 ± 0.30	3.8 ± 0.1
Dakamji	Garoua	0.23 ± 0.02	25.00 ± 1.00	2.3 ± 0.1
	Maroua	0.23 ± 0.01	21.30 ± 1.00	2.1 ± 0.1
	Mokolo	0.30 ± 0.01	21.20 ± 1.00	2.2 ± 0.2
	Mora	0.31 ± 0.01	20.70 ± 1.00	2.2 ± 0.2

DM: Dry Matter

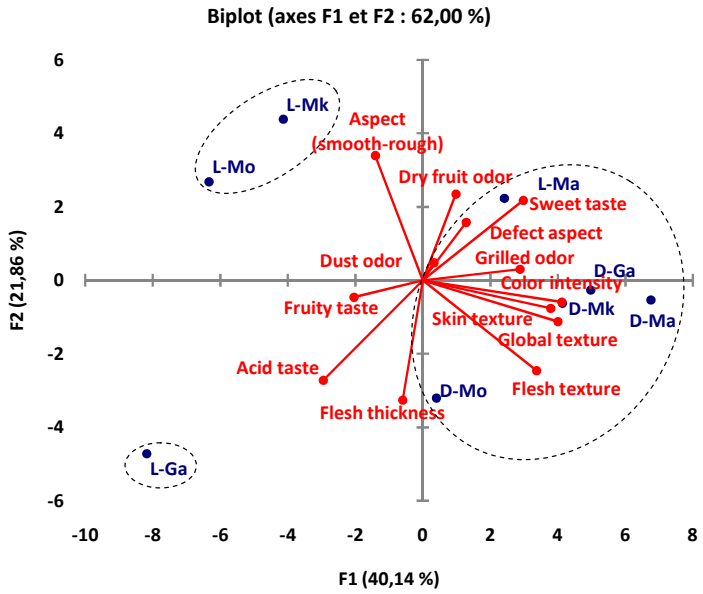

Fig. 2. Sensory attributes of *Jaabi* as affected by variety and origin of the fruits
(Ecotypes: L= Lammuji; D= Dakamji / Origins: Ga = Garoua; Ma = Maroua; Mk = Mokolo; Mo = Mora)

From the observations above, *Jaabi* samples can be divided into 3 different clusters as evidenced on (Fig. 2): C_1 (D-Ga, D-Ma, D-Mk, D-Mo and L-Ma), C_2 (L-Ga) and C_3 (L-Mk and L-Mo). One sample was chosen from clusters C_2 and C_3, and 2 samples from C_1, for the consumer study. In this respect the samples chosen were: L-Ga, L-Mo, L-Ma, D-Ma and D-Mk.

Concerning *Yaabande*, the relationships between samples and their descriptors according to the sensory panel scoring (Fig. 4), indicates a clear difference between samples processed in the sun and samples processed otherwise (stifled or steamed). The sun processed samples constitute an isolated class compared to the other samples. *Yaabande* prepared by sun-baking is more granular both by tasting and by visual observation. This observation is evidenced by the sensory profiles of the samples (Fig. 5). Sun processed samples are characterized by high chewing texture and in mouth fineness, while cakes from steam and stifle baking are more firm in mouth.

The *Yaabande* cakes were divided in 3 clusters according to the sensory attributes (Table 6): C_1 (D-Ga-Vapor, L-Ga-Vapor), C_2 (D-Ma-Stifle, D-Ma-Vapor, D-Mk-Vapor, L-Ma-Vapor, L-Mk-Vapor, Mix-Ga-Vapor) and C_3 (D-Mo-Sun, L-Mo-Sun). Four samples out of these classes were chosen for consumer test (D-Ga-Vapor, D-Ma-Stifle, D-Mk-Vapor and L-Mo-Sun). The choice of 2 samples in C2 was due to the high density of this class.

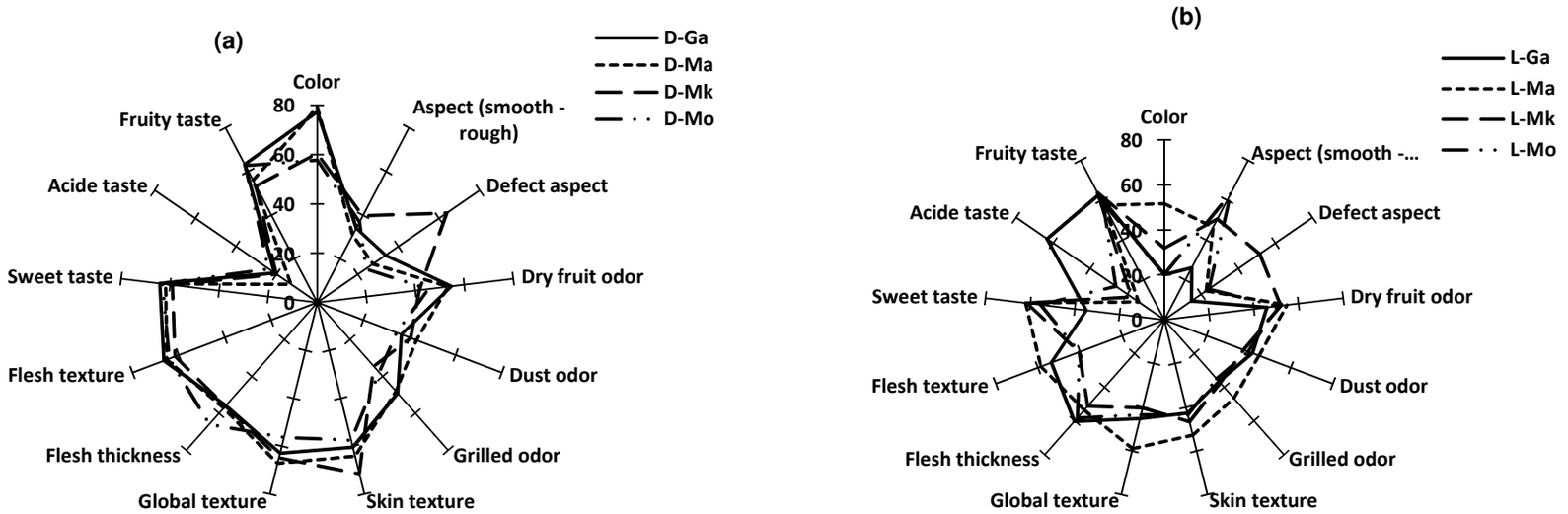

Fig. 3. Sensory profiles of *Jaabi Dakamji* (a) and *Jaabi lammuji* (b) as affected by origin of the product

(Ecotypes: L= Lammuji; D= Dakamji / Origins: Ga = Garoua; Ma = Maroua; Mk = Mokolo; Mo = Mora)

Table 4. Correlation table of sensory attributes of *Jaabi Dakamji* as perceived by panelists

Variables	Color intensity	Aspect (smooth-rough)	Defect aspect	Dry fruit odor	Dust odor	Grilled odor	Skin texture	Global texture	Flesh thickness	Flesh texture	Sweet taste	Acid taste	Fruity taste	Pulp mass	Sugar content	Titrable acidity
Color intensity	**1**															
Aspect (smooth-rough)	-0.874	**1**														
Defect aspect	-0.345	0.705	**1**													
Dry fruit odor	0.934	-0.906	-0.611	**1**												
Dust odor	0.443	-0.330	0.336	0.119	**1**											
Grilled odor	**0.954**	-0.911	-0.572	**0.998**	0.179	**1**										
Skin texture	-0.096	0.394	0.898	-0.442	0.712	-0.386	**1**									
Global texture	0.649	-0.384	0.380	0.334	0.919	0.392	0.683	**1**								
Flesh thickness	-0.611	0.181	-0.529	-0.340	-0.635	-0.389	-0.644	-0.878	**1**							
Flesh texture	0.756	-0.818	-0.780	0.940	-0.209	0.917	-0.714	-0.007	-0.048	**1**						
Sweet taste	0.389	-0.527	-0.823	0.691	-0.616	0.644	-0.923	-0.446	0.306	0.895	**1**					
Acid taste	-0.706	0.688	0.060	-0.473	-0.912	-0.521	-0.369	-0.860	0.542	-0.186	0.249	**1**				
Fruity taste	0.068	-0.205	-0.691	0.411	-0.851	0.354	-0.925	-0.697	0.474	0.690	0.938	0.568	**1**			
Pulp mass	-0.944	0.935	0.619	**-0.997**	-0.180	**-0.997**	0.418	-0.370	0.338	-0.923	-0.654	0.535	-0.359	**1**		
Sugar	0.594	-0.278	-0.074	0.658	-0.242	0.650	-0.227	0.154	-0.524	0.649	0.570	0.093	0.496	-0.599	**1**	
Titratable acidity	-0.068	0.339	0.140	0.081	-0.688	0.052	-0.252	-0.366	-0.120	0.227	0.434	0.698	0.600	0.000	0.761	**1**

Values in bold and underlined are significantly different from zero, α=0.05

Table 5. Correlation table of sensory attributes of *Jaabi Lammuji* as perceived by panelists

Variables	Color intensity	Aspect (smooth-rough)	Defect aspect	Dry fruit odor	Dust odor	Grilled odor	Skin texture	Global texture	Flesh thickness	Flesh texture	Sweet taste	Acid taste	Fruity taste	Pulp mass	Sugar content	Titrable Acidity
Color intensity	**1**															
Aspect (smooth-rough)	0,064	**1**														
Defect aspect	0,138	0,398	**1**													
Dry fruit odor	0,840	0,585	0,421	**1**												
Dust odor	0,593	-0,342	-0,712	0,220	**1**											
Grilled odor	**0,965**	-0,105	-0,115	0,700	0,779	**1**										
Skin texture	**0,997**	0,133	0,149	0,873	0,578	**0,955**	**1**									
Global texture	0,816	-0,129	-0,458	0,530	0,943	0,928	0,810	**1**								
Flesh thickness	-0,670	-0,345	-0,828	-0,796	0,199	-0,459	-0,677	-0,119	**1**							
Flesh texture	0,561	-0,639	-0,621	0,061	0,929	0,751	0,521	0,843	0,152	**1**						
Sweet taste	0,648	0,746	0,626	**0,950**	-0,087	0,450	0,690	0,243	-0,842	-0,250	**1**					
Acid taste	-0,662	-0,754	-0,579	**-0,960**	0,042	-0,473	-0,705	-0,284	0,815	0,221	**-0,998**	**1**				
Fruity taste	-0,473	-0,463	0,463	-0,547	-0,659	-0,538	-0,515	-0,728	-0,072	-0,338	-0,393	0,446	**1**			
Pulp mass	-0,940	0,016	-0,402	-0,784	-0,351	-0,853	-0,927	-0,598	0,832	-0,421	-0,651	0,644	0,157	**1**		
Sugar	-0,581	-0,797	-0,116	-0,863	-0,259	-0,491	-0,637	-0,493	0,425	0,052	-0,832	0,862	0,826	0,393	**1**	
Titratable Acidity	-0,533	-0,865	-0,537	-0,907	0,109	-0,344	-0,586	-0,200	0,712	0,336	**-0,976**	**0,982**	0,497	0,488	0,900	**1**

Values in bold and underlined are significantly different from zero, α=0.05

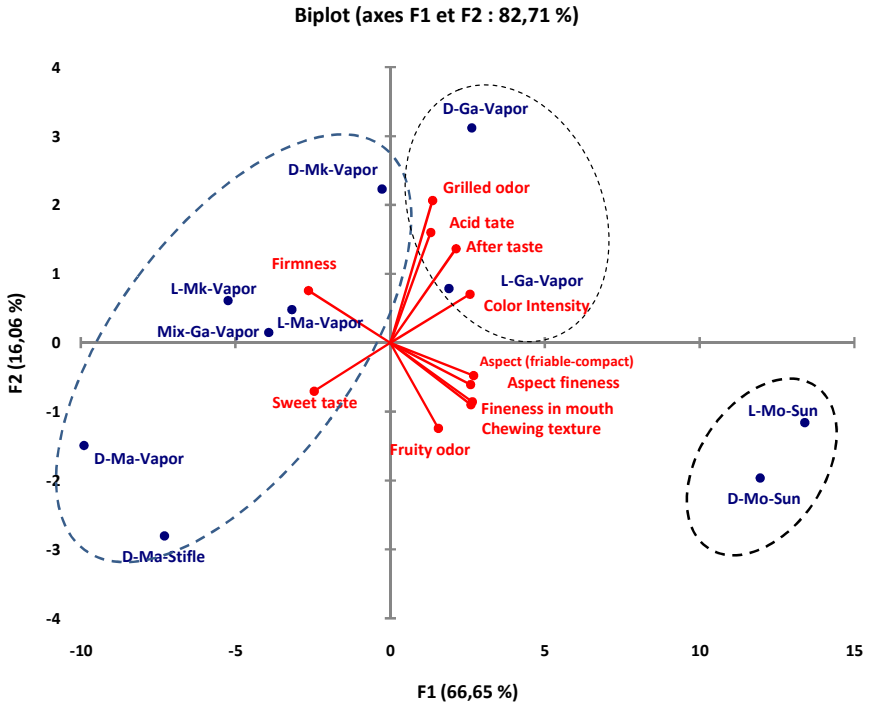

Fig. 4. Sensory attributes of *Yaabande* cake as affected by fruit variety, origin and processing method

(Ecotypes: L= Lamouji; D= Dakamji; Mix = mixture of varieties / Origins: Ga = Garoua; Ma = Maroua; Mk = Mokolo ; Mo = Mora / Processing method : Vap = Steam cooking ; Sun = Sun drying ; Stifle = Stifle cooking)

3.3 Consumer Testing

3.3.1 Consumer acceptance of Jaabi

(Table 7) shows overall appreciation of *Jaabi* sample regarding appearance, taste and acceptability. It is noted that all samples are globally acceptable since the mean scores of acceptability and taste are greater than a score of 6 (slightly pleasant).

The three variables (appearance, taste and acceptability) are positively correlated as shown by the PCA on (Fig. 6) for African and Non-African consumers. It is noted that 97.31% and 99.75% of these relations are represented by the two first components (F1 & F2) respectively for African and Non-African consumers. From the PCA plot, the homogeneous and nice appearance of L-Ga is the main criteria of acceptability of this sample both by African and Non African consumers. On the other hand, African consumers preferred the taste of L-Mo, while Non Africans preferred D-Ma for the same attribute. Based on the answers of consumers concerning criteria of choice, the taste of the dry fruit appears as the main criteria by which *Jaabi* consumers choose their product (Fig. 7). This is normal since, before buying the fruit, consumer use to taste it. This taste has preferably to be sweet. In fact, up to 80% of consumers prefer sweet *Jaabi* as shown on (Fig. 8). The same figure indicates that appearance of the fruit is characterized by its color which should be either red or Yellow, while on eating, the pulp should preferably be floury.

Table 6. Main classes of *Yaabande* cake based on sensory attributes

Classes		
1	**2**	**3**
D-Ga-Vapor	D-Ma-Stifle	D-Mo-Sun
L-Ga-Vapor	D-Ma-Vapor	L-Mo-Sun
	D-Mk-Vapor	
	L-Ma-Vapor	
	L-Mk-Vapor	
	Mix-Ga-Vapor	

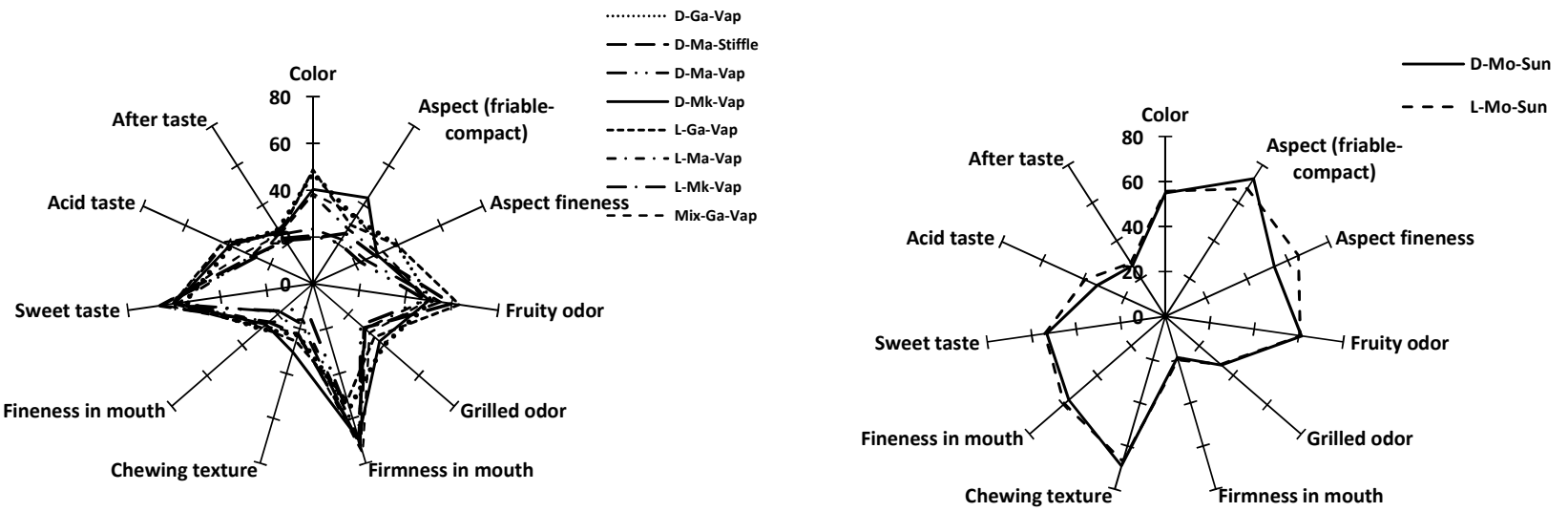

Fig. 5. Sensory profiles of *Yaabande* as affected by processing methods

(Ecotypes: L= Lamouji; D= Dakamji; Mix = mixture of varieties / Origins: Ga = Garoua; Ma = Maroua; Mk = Mokolo ; Mo = Mora / Processing method : Vap = Steam cooking; Sun = Sun drying ; Stifle = Stifle cooking)

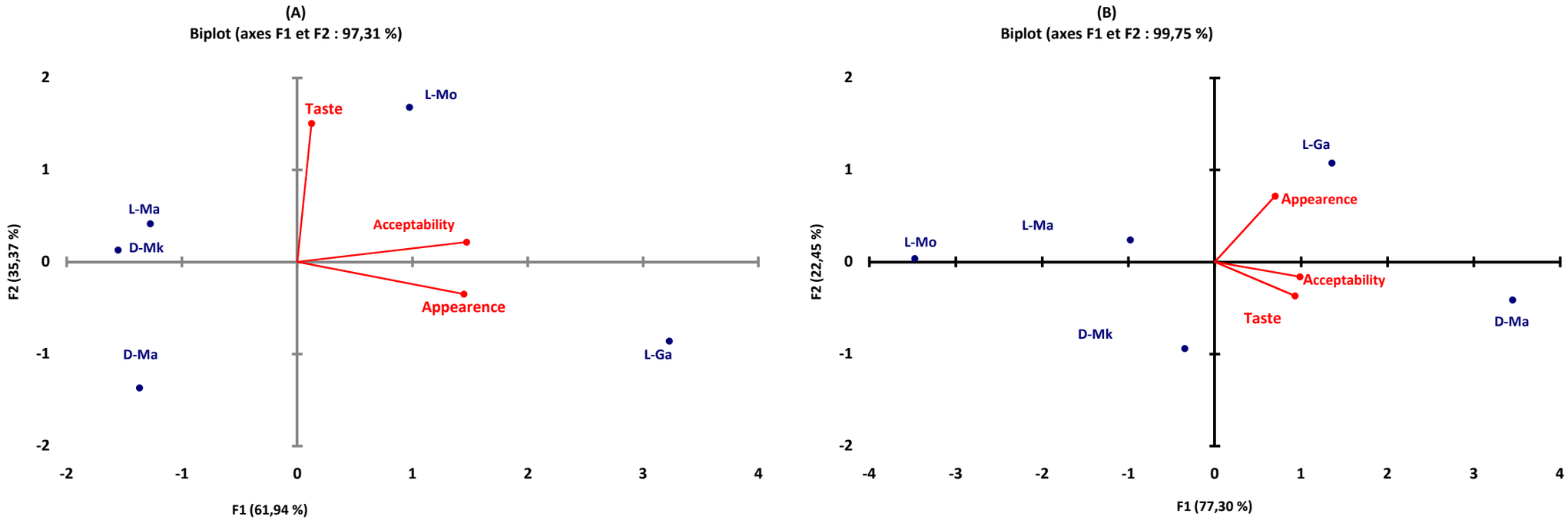

Fig. 6. Relationship between appearance, taste and acceptability of *Jaabi* samples as perceived by African (A) and non-African (B) consumers

Based on these data, African and non African consumers, do not prefer *Jaabi* in the same way (Fig. 9). Africans accept almost at equal level, all samples from different origin, though the L-Ga is preferred for its appearance. On the contrary, non African consumers have a clear preference for D-Ma, apparently for its taste, L-Ga appearing as a second choice for its appearance. The other samples appear as not preferred by these consumers. In fact, the small number of non Africans involved in the consumption test may constitute a limit for the significance of the data obtained, since, on the other hand, many of them discovered the product during the test, while Africans consumers are used to it.

3.3.2 Consumer acceptance of Yaabande

Globally, all *Yaabande* samples are acceptable and considered as pleasant, since scores are close to 7 (pleasant) (Table. 8). This acceptability is highly correlated to the taste and the appearance of the product for African consumers, while for Non African consumers, it is mainly correlated to taste only (Fig. 10).

Yaabande taste, as perceived by consumers, includes, out of the sweetness, in mouth sensations on eating since, from the question related to global preference attributes of the product, consumers reply by texture attributes (Fig. 11). In this respect, *Yaabande* cake should preferably have a yellowish aspect, a crumbly texture in mouth, and a floury flesh.

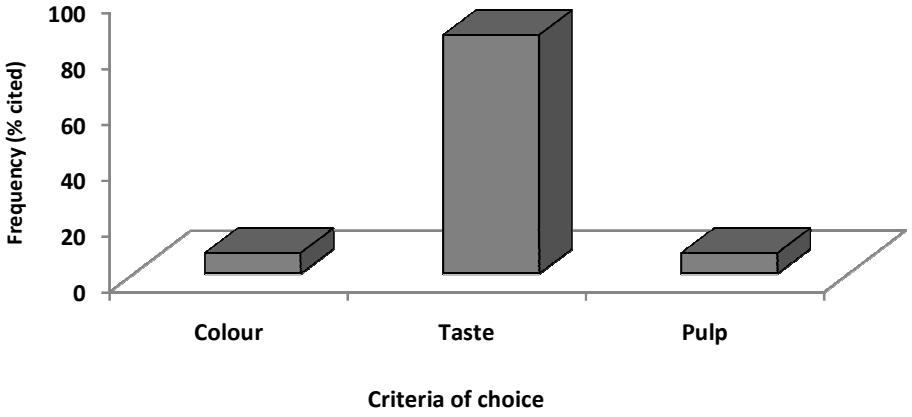

Fig. 7. Criteria of choice by *Jaabi* consumers

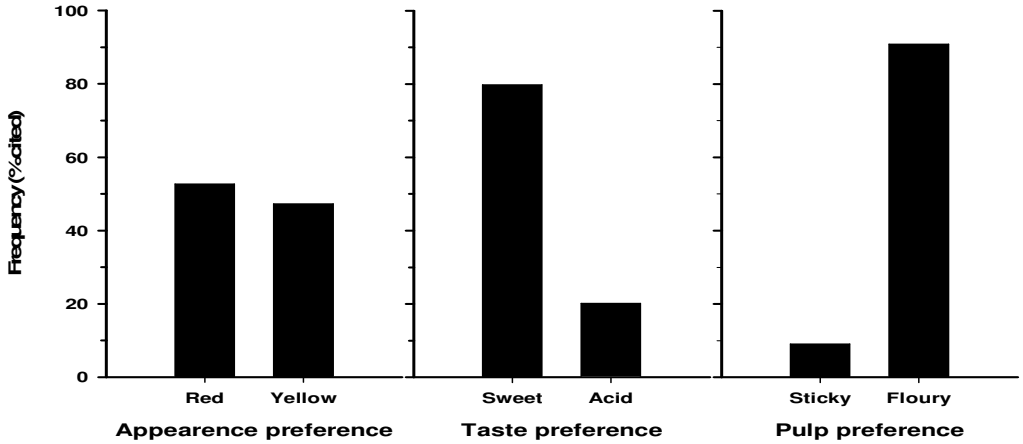

Fig. 8. Consumer preference of *Jaabi* related to appearance, taste and pulp characteristics of the dry fruit

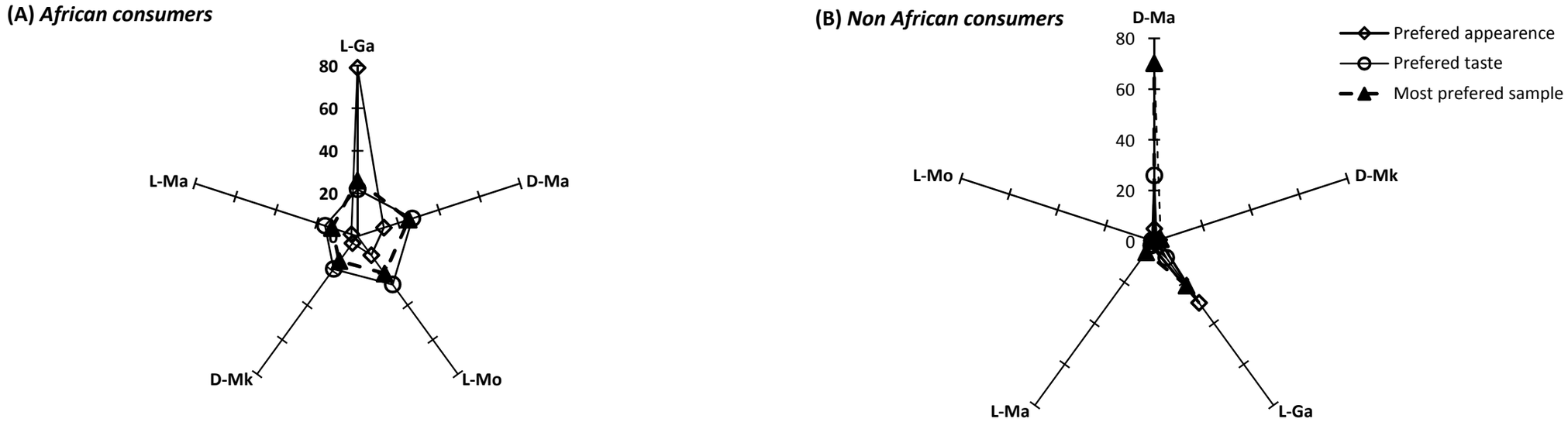

Fig. 9. Preference and acceptance of *Jaabi* by African and non African consumers as affected by the origin of the product

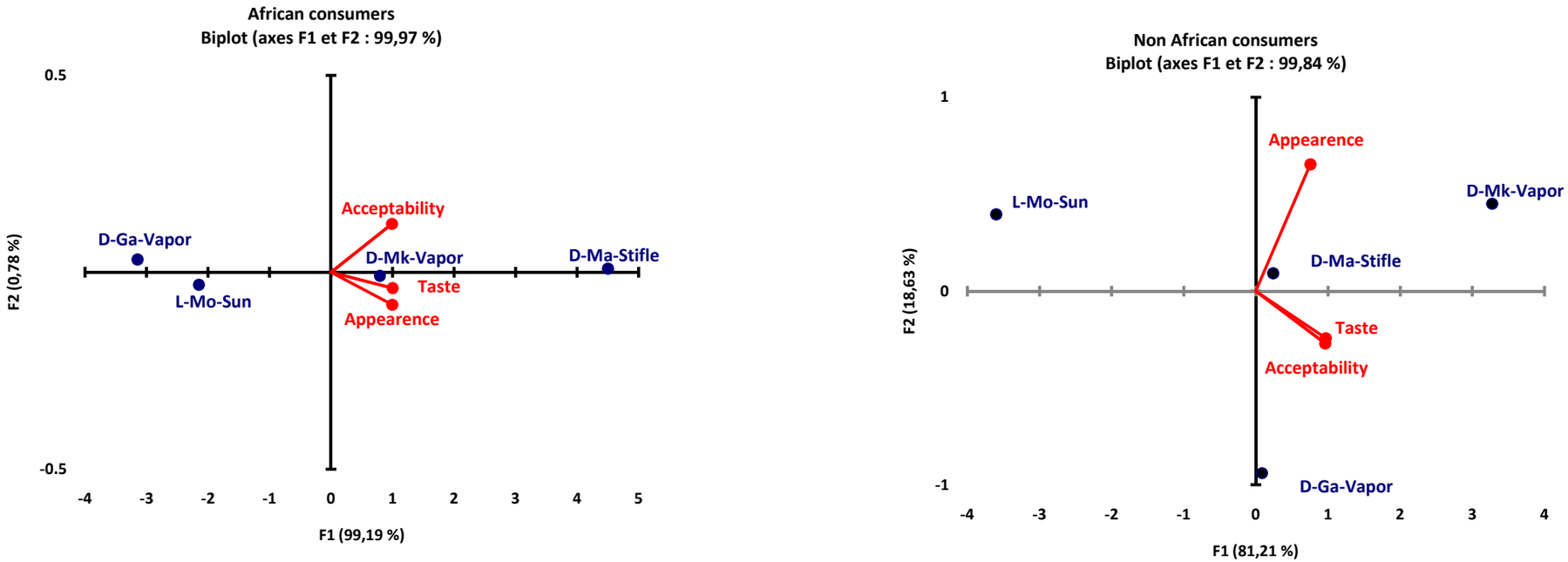

Fig. 10. Relationship between appearance, taste and acceptability of *Yaabande* samples as perceived by African and Non-African consumers

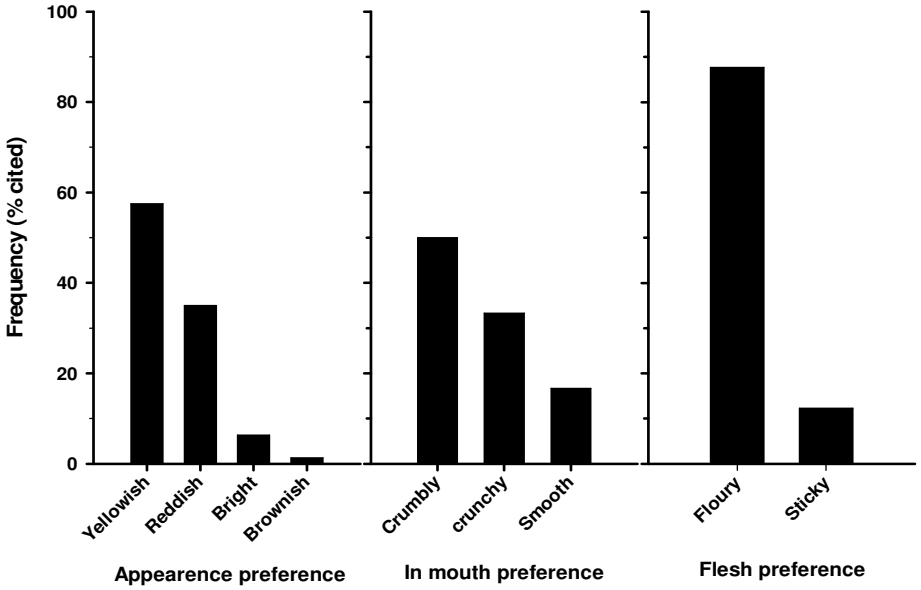

Fig. 11. Consumer preference of *Yaabande* related to appearance, in mouth and flesh characteristics of the product

Table 7. Mean overall scores of *Jaabi*

Samples	Appearance	Taste	Acceptability
D-Ma	5,7 ± 1,8	6,2 ± 2,0	6,3 ± 1,9
D-Mk	5,7 ± 1,6	6,3 ± 1,7	6,2 ± 1,6
L-Ga	7,8 ± 1,3	6,2 ± 1,9	6,5 ± 1,7
L-Ma	5,8 ± 1,5	6,4 ± 1,7	6,3 ± 1,6
L-Mo	6,2 ± 1,7	6,5 ± 1,6	6,4 ± 1,5

Table 8. Mean overall scores of *Yaabande*

Samples	Appearance	Taste	Acceptability
D-Ga-Vapor	6,0±1,5	6,2±1,7	6,4±1,5
D-Ma-Stifle	7,1±1,7	7,2±1,5	7,2±1,5
D-Mk-Vapor	6,8±1,5	6,9±1,3	6,9±1,2
L-Mo-Sun	6,2±1,4	6,0±1,8	6,0±1,7

4. CONCLUSION

This study shows that the taste of *Jaabi* and *Yaabande* is the main sensory attribute governing the consumption of these products. All *Jaabi* and *Yaabande* samples are globally acceptable by African consumers, whatever the origin and the variety. Meanwhile, it should be noted that throughout the study, no reference was made by consumers to the aroma complex and therapeutic properties of the products. Thus, the market development of *Jaabi* and resulted products is just based on proposing a product presenting original taste of the product. In this respect, standardizing the process procedures appears as an option for the market development. Associated to this option, it should be interesting to determine physico-chemical compounds which build up the taste of the products.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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